```
F. 141 - Adie 1526 = +0.08
\therefore Cent. Obs. Nor. — Adie 1526 = -0.22
             F. 182 - Adie 1526 = -0.16
.: Cent. Obs. Nor. — Adie 1526 = -0.25
F. 150 — Adie 1526 = —0.03

∴ Cent. Obs. Nor. — Adie 1526 = —0.23
```

The means of these give:

```
F. Waldo, October, 1883, Cent. Obs. Nor. — Adie 1526 = -0.06
T. Russell, June, 1884, Cent. Obs. Nor. — Adie 1526 = -0.24
```

The barometer Adie 1526, with a correction of +0.002 inch, equal to 0.05 mm., was adopted by General Greely as the standard of the Signal Service in March, 1887. This barometer has been practically the Signal Service standard since December, 1880. With the correction of +0.002 applied, the difference between pressures as assigned by Cent. Obs. Nor. and Adie 1526 is -0.11 mm. as observed by F. Waldo, and -0.29 as observed by T. Russell, the Cent. Obs. Nor. being lower. These figures do not indicate change in the barometers but personal differences in the way of observing.

October 1883.

```
F. 152 — Adie 1555 = —0.27

.: Cent. Obs. Nor. — Adie 1555 — —0.27

F. 132 — Adie 1555 = —0.29

.: Cent. Obs. Nor. — Adie 1555 = —0.38
                                   June, 1884.
F. 152 — Adie 1555 = -0.83

.: Cent. Obs. Nor. — Adie 1555 = -0.83
F. 132 — Adie 1555 = -0.26

.: Cent. Obs. Nor. — Adie 1555 = -0.35

F. 141 — Adie 1555 = -0.06
.: Cent. Obs. Nor. — Adie 1555 = -0.31

F. 150 — Adie 1555 = -0.19

.: Cent. Obs. Nor. — Adie 1555 = -0.39
```

The means of these give:

```
F. Waldo, October, 1883, Cent. Obs. Nor. — Adie 1555 = —0.32
T. Russell, June, 1884, Cent. Obs. Nor. — Adie 1555 = —0.34
```

The barometer Adie 1555 was used with a correction of +0.002 inch, equal

The barometer Adie 1555 was used with a correction of ± 0.002 inch, equal to ± 0.05 mm., therefore the difference between Cent. Obs. Nor. and Adie 1555, as found by Waldo, was ± 0.37 mm., and as found by Russell, ± 0.39 mm. This barometer was fitted with a new tube and otherwise altered October, 1885, so the above correction no longer applies.

F. 152 was compared at Yale College Observatory, New Haven, with a Green barometer and with the new standard of the Panama Canal Survey, October 27, 1883, by F. Waldo. At Harvard College Observatory, Cambridge, F. 152 was compared with Newman 68, October 31 and November 1, 1883, by A. Searle and F. Waldo.

F. 152 was compared with the barometers 465 and 1707 at the Signal

1883, by A. Searle and F. Waldo.
F. 152 was compared with the barometers 465 and 1707 at the Signal Service station, Boston, November 2 and 3, 1883, by O. B. Cole and F. Waldo, and with Newman No. 33 at the Canadian Meteorological Observatory, Toronto, by C. Carpmael and F. Waldo.
The same barometer, F. 152, was compared on November 13 and 14, with the Signal Service barometer Adie 1600 at the Maritime Exchange, New York, by F. Waldo, and with Adie 1712 at the Maritime Exchange, Philadelphia, by Mr. Townsend and F. Waldo.
F. 141, 152, 150, and 132 were compared with F. 177 and 178 at the Signal Office, Washington City, in June, 1884, by T. Russell and W. H. Hammon.
The adopted results of all the comprrisons are summarized in the following table:

Table of final adopted results.

```
St. Petersburg Cent. Obs. Nor. — Berlin, Preuss. Stat. Bur. F. 76 = -0.04
— Berlin, Nor. Aich. Kom. F. 38 = -0.05
— Berlin, Nor. Aich. Kom. F. Nor. = -0.25
                                                   - Vienna, Cent. Anst. Pistor 279 = -0.08
- Hamburg, Seewarte, F. 9 = -0.50
- Hamburg, Seewarte, Fuess Nor. = -0.04
- Kew, Normal = -0.10
                        ٤.
                                                   - Paris, Int. Bur. F. 137
                                                                                                             =-0.24
                                                   - Paris, Int. Bur. Nor. I
                        46
                                                      - Paris, Int. Bur. Nor. II
                                                                                                               =-0.20
                                                   - Paris, Regnault's Nor. College de
                                                            France
                                                   - Washington, Sig. Ser. Green St'd, with correction of -0.10 mm.
                        46
                                                   applied; Waldo

Washington, Sig. Ser. Green St'd,
                        "
                                                            with correction of -0.10 mm.
                                                            applied; Russell
                                                   - Washington, Sig. Ser. St'd Adie
1526, with correction of +0.05
mm. applied; Waldo
```

| St. Petersburg Cent. Obs. N | or. — Washington, Sig. Ser. St'd Adie |
|-----------------------------|--|
| | 1526, with correction of +0.05 |
| | mm. applied; Russell $=-0.29$ |
| " | - Washington, Sig. Ser. Adie 1555, |
| 1 | with correction of +0.05 mm. |
| | |
| | applied; Waldo = -0.87 |
| " | - Washington, Sig. Ser. Adie 1555, |
| | with correction of +0.05 mm. |
| | applied; Russell = -0.39 |
| " | - New Haven, Yale Obs., Green = -0.02 |
| | |
| •• | - New Haven, Green 2725, Panama |
| | Canal St'd $=$ -0.16 |
| 44 | — Cambridge, Har. Col. Obs., New- |
| | • $man 68$ = $+0.19$ |
| | - Boston, Sig. Ser. No. 465 $= +0.35$ |
| " | — Doston, Sig. Ser. No. 400 — — — — — 0.06 |
| i | - Boston, Sig. Ser. No. 1707 $=$ -0.05 |
| 44 | - Toronto, Met. Obs., Newman 33, |
| | with correction of +0.18 mm. |
| | applied $=-0.14$ |
| " | - New York, Maritime Exchange, |
| | |
| | Adie 1600 $= -0.29$ |
| " | - Philadelphia, Maritime Exchange, |
| | A die 1712 = -0.05 |

In these comparisons of barometers no account was taken of any slight variations there might be in the height of meniscus in open end of the Fuess syphon barometers. The capillary action of the glass on the surface of the mercury will vary a little from time to time with the height of meniscus, depending on the cleanness of the glass. During the time of the comparisons this action was assumed to be constant.

The corrections of the Fuess barometers used in the Table of Final Results to reduce to the Central Obs. Nor. at St. Petersburg are given below, and also the positions of their lower indices as determined in June, 1884, and July, 1886. The corrections of F. 177 and F. 178 are the corrections determined from comparisons with F. 141, 150, 152, and 132 after they had reached Washington City:

F. 141 — 0.25, lower index exactly at zero of graduation.
F. 150 — 0.20, lower index 0.14 mm, above zero of graduation.
F. 152 — 0.00, lower index 0.01 mm, below zero of graduation.
F. 132 — 0.09, lower index exactly at zero of graduation.
F. 177 — 0.11, lower index exactly at zero of graduation. F. 178 - 0.11, lower index 0.08 mm. below zero of graduation.

ATMOSPHERIC ELECTRICITY.

[Translated by Sergeant ALEX. McADIE, Signal Corps.]

The following is from a long and important article by Prof. F. Exner, "Ueber die Ursache und die Gesetze der atmosphärischen Electricität." "Repertorium der Physik, xxii Band. Heff 7-8, 1886." Only that portion bearing on the relation of atmospheric electricity to meteorology is here given, and in an abridged form:

Peltier's theory, in which the earth is considered simply as an electrified ball, isolated in space, and causing by induction a charged atmosphere, is considered by the author as the theory best in accord with all the experimental determinations thus far made.

Of the three different agencies for getting the electrification of the air, viz.,

by flame, water dropping, and the burning match, the first named, according to Pellat, is the most, and the match the least, efficient of collectors.

All the different observations seem to agree in this, that in ordinary fine weather the potential of the air is positive compared with that of the earth. The condition of cloudiness has a marked effect upon the values of the potential, and especially when thick cumuli clouds are in proximity of the place of observation, variations and occasional negative values are likely to occur. Franklin, Beccaria, Le Monnier, Cavallo, Saussure, and their contemporaries, Franklin, Beccaria, Le Monnier, Cavallo, Saussure, and their contemporaries, agree in this. Negative values, as a rule, occur during stormy weather. Quetelet, observing for four years, found only twenty-three instances of negative electricity, and these always during stormy or rainy weather. Birt, in five years, had 14,515 cases of positive and only 665 cases of negative electricity, and these last, as a rule, at times of rapid cloud-formation. Results of a like nature were obtained by Lamont at Munich, by Dellmann at Kreuznach, and Palmieri at Naples. F. Duprez found, on an average, twenty-three cases of positive to one negative indication, and the latter generally during thunder-storms. Everett, from observations in Nova Scotia, obtained similar results. Exper's own experience has been, that in normal weather, omitthunder-storms. Everett, from observations in Nova Scotia, obtained similar results. Exner's own experience has been, that in normal weather, omitting local influence, negative electricity is very rare. Dellmann gives as a law, based upon twenty years' experience, that "the atmospheric electricity at a place is, as a rule, of one sign." This important fact has also been commented upon by Wislicenus, at Saint Louis, Mo., and elsewhere. Not only above the earth surface, but also above the sea surface, is the air in its normal condition positively electrified mal condition positively electrified.

In general, the observations referred to above have shown that the difference between the potentials of the air and the ground increases with height. Beccaria noticed that the higher his collecting apparatus the greater the indications.

-0.11 Lamanon and Mongez found always a strong positive indication on the Peak of Teneriffe. Saussure gives numerous similar instances, and suggests the desirability of recording with each observation, not the absolute height above the level of the sea, but the relative height of the place of observation above

its surroundings

With regard to the yearly period, all the various observations seem to agree in this, that the average electrification of winter is always stronger than that of summer, while during spring and autumn a mean value prevails. This relation is confirmed by Quetelet from five years' continuous observations at Brussels, winter and summer at Brussels is about 13 to 1, and at Saint Louis about 5 to 1. The cause of this difference is, in some way, connected with the amount of water vapor in the atmosphere,

With regard to the daily period, Saussure, Schübler, Crosse, Quetelet, Dellmann, Secchi, Wislicenus, W. Thomson, Everett, F. Denza, Roiti, and Palmieri agree as to the existence of two daily maxima and minima. Most of these tend to prove the existence of a strong maximum about the time of sunset, or shortly after, and a maximum about noon. Two maxima of less degree, and more or less uncertainty, are shown in the morning hours, and two feeble minima during the night. On the other hand, Mascart found at Paris but one maximum and minimum, which perhaps may be accounted for by the influences of the surrounding great city, and although observations made at Lisbon during 1877-'78 show but one maximum and minimum, yet we may safely say that, in

general, there are two maxima and minima daily.

Saussure, Schübler, and Crosse have all advanced the statement that a heavy formation of dew is always accompanied by a maximum, and that the chief maximum occurs at the time of sunset and a secondary one at sunrise, while the chief minimum always occurs at the time of the greatest heat of the day. Quetelet also came to the conclusion that the daily variation was inversely as the temperature. Dellman found that the daily maximum occurred about the time of minimum temperature and the minimum electricity with the maximum temperature. There is also some connection between the electrification and the humidity of the air. At times of prolonged dryness the values are less variable than at times of rapid moisture changes; and, in general, we may say the electrification of the air varies inversely as the temperature and humidity

With regard to the geographical position of the place of observation, and its possible influence on the indications, we know only that stations near together,

omitting local influences, will give comparable results.

It has been known for some time that with fog or haze generally a strong positive charge was noted, and it is characteristically so with fogs that appear early in the morning and which, in lifting, foretell a clear, fine day. This has been often noted, and is mentioned by Beccaria, Ronayne, Henley, Volta, Saussure, Crosse, Schübler, Everett, Wislicenus, and was particularly studied by Dellman. This may be due to the accumulation of positive electricity by the fall in temperature and increase in the fog particles.

We next come to the question of the influence exerted on the electricity of the air by the formation of clouds and the occurrence of rain. The experience of all observers is that the rain drops are negatively electrified. occur but seldom, and then mainly during winter or when the precipitation occurs as snow from high, cold regions. Everett and Lephay, and some modern observers, have found that hail and rain were generally negatively electrified, and the more sudden and heavy the rain, the stronger the electrification. The clouds and vapor in the air appear to be negatively electrified as well as the rain. This is important, inasmuch as it shows that the cause of the negawhich give a maximum in January and a minimum in June or July. The the rain. This is important, inasmuch as it shows that the cause of the negasame relation of yearly maxima and minima is shown in the observations at tive electrification is not to be sought in the friction of the falling drops with Kew, at Naples, at Windsor, and at Saint Louis. The ratio of the values of the air. Palmieri and Quetelet found that large cloud masses are electrification. negatively in their centre, but positively electrified at the edges. the clearer and colder the weather, the greater the electrification.

FOG PREDICTIONS FOR THE BANKS OF NEWFOUNDLAND.

[By Sergeant E. B. Garriott, Signal Corps.]

With the solution in recent years of many of the problems of meteorology the science has assumed a prominence proportional to the practical value of the discoveries made. Prominent among subjects which have more latterly received special consideration is ocean meteorology, more particularly as relates to North Atlantic storms, ice, and fog. As regards the storms which traverse, or have their origin over, the ocean, the general laws attending their development and movement have been fairly well determined, and valuable information and forecasts are furnished for the benefit of foreign and domestic maritime interests. It has also been found possible to furnish information relative to the location and movement of ice-fields in the vicinity of the Banks of Newfoundland. Not the least valuable, in probable results, have been the investi-gations made in connection with fog, as encountered in the trans-Atlantic routes. Observations made during the past six months, with special reference to the denser fog formations over the Banks of Newfoundland, show that these conditions, in every instance reported, have been observed within areas of low barometric pressure, and, as a rule, in the eastern quadrants, considerably in advance of the centres of the depression. The fact that storms move eastward from the North American continent has been established, and it is possible to calculate their rate of progression. It has been shown by observation that the conditions favorable for the development of fog over the Banks accompany the the shift of wind to southerly with the approach of cyclonic areas, whereby the warm air of more southern latitudes is drawn in contact with the ice-fields and cold Arctic currents. This shift of wind precedes the arrival in these longitudes of the centres of low barometer areas of average strength from one to two days. This period, considered with the time occupied by storm-centres in reaching the coast after having been located over the North American continent, allows a considerable margin of time for forecasting the probable presence of fog over the Banks. The average time occupied by trans-Atlantic steamers between the port of New York and the fiftieth meridian is from three to four days, and it is not unreasonable to anticipate, for the near future, the forecasting of fog in the trans-Atlantic routes, not only for cabling, but for the benefit of outward-bound steamers.

METEOROLOGICAL TABLES.

Table showing the dates of the last snowfall at stations of the Signal Service, east of the Rocky Mountains, for each winter from 1873-'74 to the winter of 1885-'86, inclusive.

| Districts and stations. Stations established. | Stations | Winter of— | | | | | | | | | | | | |
|--|--|---|--|---|--|--|---|--|---|---|---|---|--|--|
| | 1873-'74. | 1874-'75. | 1875-'76. | 18 7 6-`77. | 1877-'78. | 1878-'79. | 1879-'80. | 1880–'81. | 1881-'82. | 1882-'83. | 1883-'84. | 1884-'85. | 1885-186. | |
| New England. Eastport, Me | Jan. 15, 1871 Dec. 1, 1870 Sept. 1, 1880 Dec. 10, 1872 Jan. 10, 1871 Dec. 22, 1873 Nov. 1, 1870 Dec. 10, 1873 Dec. 10, 1873 Dec. 10, 1873 May 24, 1871 Dec. 10, 1873 Jan. 1, 1871 Dec. 10, 1873 May 24, 1871 Nov. 1, 1870 Dec. 15, 1873 Mar. 16, 1880 May 24, 1871 | Apr. 30 Apr. 28 Apr. 28 Apr. 28 Apr. 28 | Apr. 19 Apr. 19 Apr. 19 Apr. 18 Apr. 24 Apr. 19 Apr. 18 Apr. 19 Apr. 18 Apr. 19 Apr. 4 | May I May II May II Apr. 30 Mar. 25 Mar. 20 Mar. 20 Mar. 20 Mar. 20 Apr. 18 Mar. 30 | Mar. 28 Apr. 21 Mar. 28 Mar. 28 Mar. 28 Mar. 28 Mar. 28 Mar. 28 Mar. 30 Mar. 30 Mar. 30 Mar. 30 | Apr. 1 Mar. 25 Mar. 17 May 15 Apr. 5 Mar. 25 Apr. 25 Apr. 26 Feb. 26 Feb. 26 Feb. 26 Feb. 15 Feb. 15 Jan. 18 | α Apr. 19 | Apr. 17 a Apr. 24 May I May I Muy I Apr. 7 Apr. 12 Mar. 19 | Apr. 16 Apr. 14 Mar. 19 Apr. 12 Apr. 13 Mar. 31 Apr. 6 Mar. 31 Apr. 6 Mar. 31 Apr. 6 Apr. 4 Apr. 4 Apr. 4 Apr. 4 Apr. 4 | May 15 | May 15 Apr. 8 Apr. 24 Mar. 30 Apr. 29 Apr. 29 Apr. 29 Mar. 30 Apr. 1 Apr. 1 Apr. 1 Apr. 1 Jan. 16 Apr. 2 Mar. 31 Apr. 29 Mar. 31 Apr. 29 Mar. 31 Apr. 2 Mar. 31 | May 10 May 30 Apr. 9 Apr. 3 | May 2 | Apr. 8 Apr. 5 Apr. 4 |
| Charlotte, N. C. Cape Hatteras and Hatteras, N. C Kitty Hawk, N. C. Macon, Fort, N. C. Smithville, N. C. Wilmington, N. C. Charleston, S. C. Augusta, Ga. Savannah, Ga. Jacksonville, Fla. | Sept. 1, 1874 Jan. 15, 1875 May 23, 1878 Oct. 15, 1875 Jan. 1, 1871 Jan. 5, 1871 Nov. 2, 1870 Jan. 1, 1871 | e e Feb. 8 | Apr. 18 | Mar. 22 Feb. 2 | Dec. 1 Mar. 18 e e e | Dec. 27 Dec. 2 | Feb. 14 Feb. 1 Feb. 20 e Jan. 19 Feb. 17 | Feb. 2 Jan. 19 Mar. 30 e Nov. 20 e Mar. 12 | Apr. 1 Jan. 24 Feb. 23 Jan. 25 Jan. 24 Jan. 24 Jan. 14 | Jan. 31 Jan. 4 Jan. 1 Jan. 30 Jan. 30 Jan. 30 | Mar. 26 Mar. 22 Mar. 22 Mar. 22 e Mar. 22 | Mar. 1 Jan. 17 Jan. 17 Jan. 17 Jan. 5 Jan. 5 Jan. 7 | Mar. 23 Mar. 23 Mar. 23 Mar. 23 Mar. 23 Mar. 23 | Mar. 10 Feb. 4 Feb. 4 Feb. 28 Feb. 28 Feb. 4 Feb. 27 Jan. 9 |